SERVICE MANUAL

SM160T
BEB16E1-06

BX50 SERIES FORKLIFT TRUCKS
Federal Environmental Protection Agency (EPA) Emission-Control Compliant
S/N 200001A~

Gasoline & LP	**400/500/550/600/650(C/P)G(H)-16** **700PGH-16**
Diesel	**400/500/550/600/650/700PD-16**

BX50

CLEAN AIR TECHNOLOGY
TODAY AND TOMORROW

WARNING

Read and observe all warnings on this unit before operating it.
DO NOT operate this equipment unless all factory-installed guards and shields are properly secured in place.

TUSK
LIFT TRUCKS

ISSUED: NOVEMBER 2006

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INTRODUCTION

This Service Manual has been developed as an information resource to help the reader learn about, understand, repair and maintain the BX50 Series forklift trucks, and the various equipment, systems, inspections, sensors, diagnostic procedures and diagnostic equipment utilized to maintain, adjust and troubleshoot these systems. Although reference is made to maintenance procedures necessary to perform servicing of this vehicle, you should refer to the applicable *Operation and Maintenance Manual* for these lift trucks for more complete maintenance information.

Tusk is involved in a concentrated and highly technical program of designing and developing cleaner burning, more efficient and more powerful engines for use in the industrial truck market. As a result, new computerized sensors, systems and diagnostic monitors have been created to make the job of maintaining and repairing these systems simple and easy.

Read this manual carefully, refer to it often and learn the repair, testing and adjustment procedures to the best of your ability. Please note that some illustrations are generic and may not look exactly like your unit in every detail.

Ensure that, when you are working on or around industrial trucks, **Safety is priority Number One**. Read, understand and obey all **WARNINGS** and **CAUTIONS**.

Follow the instructions and procedures presented in this manual when working on these lift trucks and their systems. Damage to the equipment, and possible injury to yourself or others, may result if these procedures are not adhered to carefully.

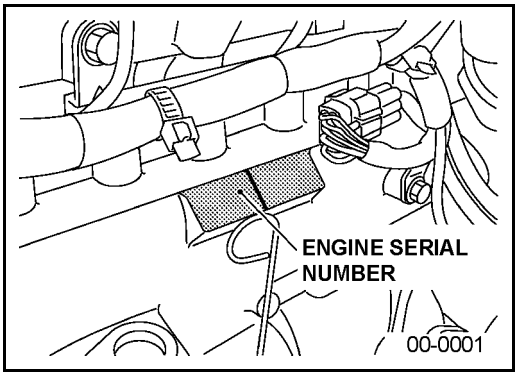
Keep this manual nearby and accessible for use when necessary. If this book becomes dirty, worn or illegible, contact Tusk for a replacement. The procedures outlined in this manual will be updated periodically. Be sure that you have the latest revision in order to learn the newest information available. Revision dates will be clearly displayed on the lower left hand corner of the cover page.

This will aid in maintaining your equipment in excellent condition and in ensuring that these lift trucks will operate safely at maximum efficiency.

ENGINE SERIAL NUMBER LOCATION

The K21/K25 engine serial number is stamped on an angled and machined pad on the right side of the engine block in the center just beneath the valve cover.

The machined boss is split vertically by a groove. The Engine Model number is on the left pad and the Engine Serial number is on the right pad.



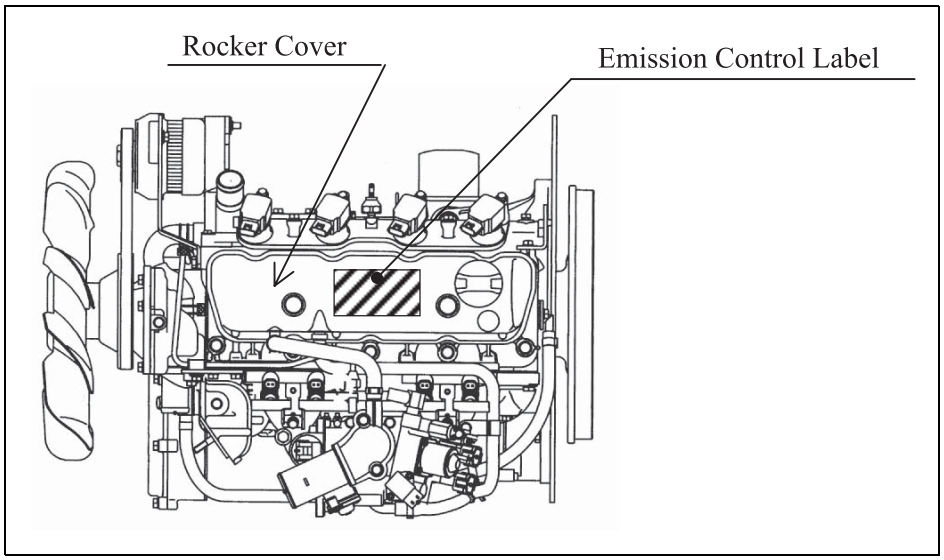
CALIFORNIA/FEDERAL EMISSION CONTROL STATEMENT FOR OFF-ROAD LSI (NON-DIESEL) ENGINES (K21 AND K25 ENGINES)

This section presents information concerning the correct labeling, warranty, parts and maintenance of K21 and K25 engines in order to comply with the EPA and CARB off-road, large-spark-ignition (LSI) engine regulations.

LABELS REQUIRED AND LABEL LOCATIONS

All “K” series engines will display the required identification label as follows.

Location on K21/K25 Series engines:



Emission compliance label (sample):

EMISSION CONTROL INFORMATION

ENGINE FAMILY:7NSXB02.548C, ENGINE DISPLACEMENT: 2.5 LITER
THIS ENGINE IS CERTIFIED TO OPERATE ON GASOLINE AND LPG.
EXHAUST EMISSION CONTROL TYPE: MPI, TBI, TWC, HO2S
USE IN VARIABLE-SPEED APPLICATIONS ONLY

IDLE SPEED	NO OTHER ADJUSTMENTS NEEDED
VALVE LASH	0.38 mm (HOT)
SPARK PLUG GAP	0.9 mm

NO OTHER ADJUSTMENTS NEEDED.
CARB EMISSION STANDARDS : HC+NOx=1.0, CO=8.3 g/bhp-hr
EPA Tier2 EMISSION STANDARDS : HC+NOx=1.3, CO=11.1 g/kW-hr

THIS ENGINE COMPLIES WITH CALIFORNIA AND U.S. EPA REGULATIONS FOR 2007 LARGE NONROAD SI ENGINES.

NISSAN MOTOR CO., LTD. K25 D

2006: SEP OCT NOV DEC
2007: JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

WARRANTY

The following statement is required to be provided by regulations of the California Air Resources Board.

YOUR WARRANTY RIGHTS AND OBLIGATIONS

The California Air Resources Board is pleased to explain the emission control system warranty on your 2007 engine. In California, new off-road large spark-ignition (LSI) engines must be designed, built and equipped to meet the state's stringent anti-smog standards.

Tusk Lift Trucks (“Tusk”) must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the carburetor, regulator or fuel-injection system, ignition system, engine computer unit (ECM), catalytic converter and air induction system.

Also included may be sensors, hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, an Authorized Tusk Dealer will repair your LSI engine at no cost to you including diagnosis, parts and labor.

MANUFACTURER'S WARRANTY COVERAGE

The 2007 off-road large spark-ignition engines are warranted for the time periods as listed below.

If any emission-related part on your engine is defective, the part will be repaired or replaced by an Authorized Tusk Dealer.

OWNER'S WARRANTY RESPONSIBILITIES

As the off-road LSI engine owner, you are responsible for the performance of the required maintenance listed in your Operation and Maintenance Manual.

Tusk recommends that you retain receipts covering maintenance on your off-road engine, but Tusk cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

As the off-road large spark-ignition engine owner, you should however be aware that Tusk may deny you warranty coverage if your off-road large spark-ignition engine or a part thereof has failed due to abuse, neglect, improper maintenance or unapproved modifications.

Your engine is designed to operate on gasoline or LPG fuel. Use of any other fuel may result in your engine no longer operating in compliance with California's emissions requirements.

You are responsible for initiating the warranty process. The ARB suggests that you present your off-road large spark-ignition engine to an Authorized Tusk Dealer as soon as a problem exists.

The warranty repairs should be completed by the Dealer as expeditiously as possible.

If you have any questions regarding your warranty rights and responsibilities, you should contact Tusk’s Product Support Department at 1-770-385-4815.

EMISSION CONTROL WARRANTY - 36 MONTHS or 2,500 HOURS FOR GENERAL PARTS

For the first 2,500 operating hours or for a period of thirty-six months from the date of the first use by the original purchaser from an Authorized Tusk Dealer, whichever occurs first, Tusk warrants the following emission-related parts.

- Oxygen sensor
- Water temperature sensor
- LPG injector
- LPG solenoid
- Throttle chamber
- Crankshaft position sensor
- Spark plugs
- Gasoline fuel hose
- PCV valve
- Gasoline injector
- LPG pressure sensor
- Mass air flow sensor
- Ignition coil
- Camshaft position sensor
- Exhaust tube from manifold to catalytic converter
- Gasoline fuel cap

EMISSION CONTROL STATEMENTS

EMISSION CONTROL WARRANTY - 36 MONTHS or 4,000 HOURS FOR POWER TRAIN PARTS

- Intake manifold
- Exhaust manifold

LONG-TERM EMISSION CONTROL WARRANTY - 60 MONTHS or 3,500 HOURS FOR GENERAL PARTS

- ECM
- Catalytic converter
- Vaporizer

Follow the instructions in the Operations Manual concerning any other maintenance programs not required for EPA compliance.
For questions and additional information concerning EPA Diesel Engine Exhaust Regulations, contact:

Tusk Lift Trucks
14481 Lochridge Blvd., Bldg. #2
Covington, GA 30014-4908

Voice phone: (770) 385-4815
Fax phone: (770) 385-4838

FEDERAL EPA EMISSION CONTROL STATEMENT FOR OFF-ROAD DIESEL ENGINES (4D94E ENGINES)

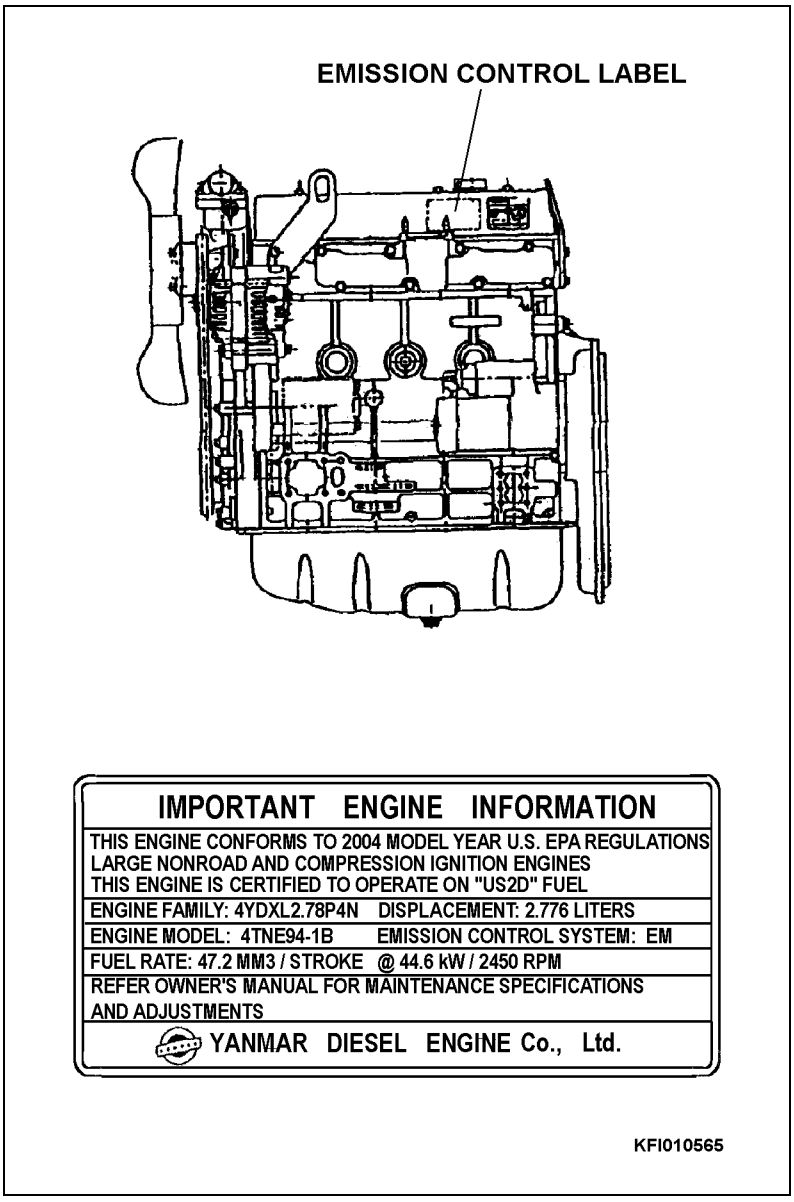
Exhaust emissions produced by diesel engines are regulated by the United States Environmental Protection Agency (EPA). This section presents information concerning the correct labeling, warranty, parts and maintenance of 4D94E diesel engines in order to comply with current EPA regulations.

LABELS REQUIRED AND LABEL LOCATIONS

All certified 4D94E diesel engines will display the required identification label as follows:

- 4D94E diesel engines: Labels will be affixed to all appropriate engines on Tusk production trucks.

Location on 4D94E Series diesel engines:


EMISSION CONTROL LABEL
IMPORTANT ENGINE INFORMATION
THIS ENGINE CONFORMS TO 2004 MODEL YEAR U.S. EPA REGULATIONS
LARGE NONROAD AND COMPRESSION IGNITION ENGINES
THIS ENGINE IS CERTIFIED TO OPERATE ON "US2D" FUEL
ENGINE FAMILY: 4YDXL2.78P4N DISPLACEMENT: 2.776 LITERS
ENGINE MODEL: 4TNE94-1B EMISSION CONTROL SYSTEM: EM
FUEL RATE: 47.2 MM3 / STROKE @ 44.6 kW / 2450 RPM
REFER OWNER'S MANUAL FOR MAINTENANCE SPECIFICATIONS
AND ADJUSTMENTS
YANMAR DIESEL ENGINE Co., Ltd.
KFI010565

EMISSION CONTROL STATEMENTS

WARRANTY

The following statement is hereby provided as required by regulations of the United States Environmental Protection Agency (EPA).

YOUR WARRANTY RIGHTS AND OBLIGATIONS

The Federal EPA and Tusk Lift Trucks ("Tusk") are pleased to explain the emission control system warranty on your 2004 or later Diesel heavy duty off-road engine. All new, heavy-duty off-road engines must be designed, built and equipped to meet the EPA's stringent anti-smog standards. Tusk must warrant the emission control system on your engine for the period of time listed below, provided there has been no abuse, damage, neglect or improper maintenance of your engine.

Your emission control system may include parts such as fuel injection pump. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, an authorized Tusk Lift Trucks dealer will repair the heavy-duty off-road engine at no cost to the owner, including diagnosis, parts and labor.

Now, Tusk hereby certifies that diesel engines for lift trucks produced in 2004 model year and after shall be regulated by Federal EPA exhaust gaseous regulations. The difference between current and EPA-certified engines is only the label attached on the engine. See available drawing and/or illustration of emission label and its location.

MANUFACTURER'S WARRANTY COVERAGE

Beginning January 1, 2004 heavy-duty off-road EPA engines are warranted for a period of five (5) years, or three-thousand (3,000) hours of operation, whichever occurs first. If any emission-related part on your engine is defective, the part will be repaired or replaced by at an authorized Tusk Lift Trucks dealer.

EMISSION-RELATED PARTS

- Fuel injection pump
- Fuel injection nozzles
- Turbocharger

OWNER'S WARRANTY RESPONSIBILITIES

As the heavy-duty off-road engine owner, you are responsible for the performance of the required maintenance listed in owner's manual (Instruction Manual). Tusk recommends that you retain all receipts and records covering the maintenance on your engine, but Tusk cannot deny warranty solely for the lack of receipts and records or for your failure to ensure the performance of all scheduled maintenance. For your reference, the following is an emission control maintenance schedule for certified Diesel engines.

• Check oil level and coolant level	Every day
• Change of lubricating oil	Every 200 hours
• Change lubricating oil filter	Every 200 hours
• Initial adjustment of valve clearance	Every 200 hours
• Change fuel filter	Every 500 hours
• Check turbocharger, rebuild or replace if necessary	Every 2,000 hours
• Adjust valve clearance	Every 2,000 hours
• Check fuel injection nozzles, replace if necessary	Every 2,000 hours

Keep records to show proof of compliance with the required maintenance practices and intervals.

- As the heavy-duty off-road engine owner you should, however, be aware that Tusk may deny your warranty coverage if your heavy-duty off-road engine or part has failed due to abuse, damage, neglect, improper maintenance or disapproved modifications.
- Your engine is designed to operate on commercial diesel fuel only. Use of any other fuel in our engine will result in the engine operating in non-compliance with the Federal EPA regulations.
  You are responsible for initiating the warranty process. It is suggested that you present your heavy duty off-road engine to an authorized Tusk Lift Trucks dealer as soon as you become aware that problem exists. The warranty repair should be completed by the dealer as expeditiously as possible.
- If you have any questions regarding your warranty rights and responsibilities, you should contact the authorized Tusk Lift Trucks dealer.

LIMITATIONS

Tusk is not responsible for resultant damages to an emission-related part or component resulting from:

- Any application or installation Tusk deems improper as explained in the Instruction Manual.
- Attachments, accessory items or parts not authorized for use by Tusk.
- Improper off-road engine maintenance, repair or abuse.
- Owner's unreasonable delay in making the product available after being notified of a potential product problem.

This warranty is in addition to the Tusk standard warranty applicable to the off-road engine product involved.

Remedies under this warranty are limited to the provision of material and services as specified herein. Tusk is not responsible for incidental or consequential damages, such as downtime or lost use of the forklift truck.

CUSTOMER ASSISTANCE – EMISSION CONTROL SYSTEMS WARRANTY

Tusk aims to ensure that the Emission Control Systems Warranty is properly administered. In the event that you do not receive the warranty service to which you believe you are entitled under the Emission Control Systems Warranty, call or write to your Tusk Lift Trucks Dealer.

Authorized dealers are recommended for major maintenance and repair work, as they are staffed with trained personnel, proper tools and are aware of the latest maintenance methods and procedures. Owners and others who desire to perform their own work should purchase a service manual and obtain current service information from their Tusk engine dealer.

Follow the instructions in the Operations Manual concerning any other maintenance programs not required for EPA compliance.
For questions and additional information concerning EPA Diesel Engine Exhaust Regulations, contact:

Tusk Lift Trucks
14481 Lochridge Blvd., Bldg. #2
Covington, GA 30014-4908
Voice phone: (770) 385-4815
Fax phone: (770) 385-4838

FORKLIFT TRUCKS COVERED IN THIS PUBLICATION

GASOLINE, LPG AND DUAL-FUEL ENGINE MODELS	
CUSHION TIRE	
400CG-16	4,000 lb. capacity, K21 gasoline engine, cushion tires
400CGL-16	4,000 lb. capacity, K21 LPG engine, cushion tires, “LPS”
400CGH-16	4,000 lb. capacity, K25 gasoline engine, cushion tires
400CGLS-16	4,000 lb. capacity, K25 gasoline engine, cushion tires, “LPS”
500CG-16	5,000 lb. capacity, K21 gasoline engine, cushion tires
500CGL-16	5,000 lb. capacity, K21 LPG engine, cushion tires, “LPS”
500CGH-16	5,000 lb. capacity, K25 gasoline engine, cushion tires
500CGLH-16	5,000 lb. capacity, K25 LPG engine, cushion tires, “LPS”
550CGH-16	5,500 lb. capacity, K25 gasoline engine, cushion tires
550CGLH-16	5,500 lb. capacity, K25 LPG engine, cushion tires, “LPS”
600CGH-16	6,000 lb. capacity, K25 gasoline engine, cushion tires
600CGLH-16	6,000 lb. capacity, K25 LPG engine, cushion tires, “LPS”
650CGH-16	6,500 lb. capacity, K25 gasoline engine, cushion tires
650CGLH-16	6,500 lb. capacity, K25 LPG engine, cushion tires, “LPS”
PNEUMATIC TIRE	
400PG-16	4,000 lb. capacity, K21 gasoline engine, pneumatic tires
400PGS-16	4,000 lb. capacity, K21 gasoline engine, pneumatic tires, “GS”
400PGL-16	4,000 lb. capacity, K21 LPG engine, pneumatic tires, “LPS”
400PGH-16	4,000 lb. capacity, K25 gasoline engine, pneumatic tires
400PGSH-16	4,000 lb. capacity, K25 gasoline engine, pneumatic tires, “GS”
400PGLH-16	4,000 lb. capacity, K25 LPG engine, pneumatic tires, “LPS”
500PG-16	5,000 lb. capacity, K21 gasoline engine, pneumatic tires
500PGS-16	5,000 lb. capacity, K21 gasoline engine, pneumatic tires, “GS”
500PGL-16	5,000 lb. capacity, K21 LPG engine, pneumatic tires, “LPS”
500PGH-16	5,000 lb. capacity, K25 gasoline engine, pneumatic tires
500PGSH-16	5,000 lb. capacity, K25 gasoline engine, pneumatic tires, “GS”
500PGLH-16	5,000 lb. capacity, K25 LPG engine, pneumatic tires, “LPS”
550PGH-16	5,500 lb. capacity, K25 gasoline engine, pneumatic tires
550PGSH-16	5,500 lb. capacity, K25 gasoline engine, pneumatic tires, “GS”

FORKLIFT TRUCKS COVERED IN THIS PUBLICATION (Continued)

550PGLH-16	5,500 lb. capacity, K25 LPG engine, pneumatic tires, “LPS”
600PGH-16	6,000 lb. capacity, K25 gasoline engine, pneumatic tires
600PGSH-16	6,000 lb. capacity, K25 gasoline engine, pneumatic tires, “GS”
600PGLH-16	6,000 lb. capacity, K25 LPG engine, pneumatic tires, “LPS”
650PGH-16	6,500 lb. capacity, K25 gasoline engine, pneumatic tires
650PGSH-16	6,500 lb. capacity, K25 gasoline engine, pneumatic tires, “GS”
650PGLH-16	6,500 lb. capacity, K25 LPG engine, pneumatic tires, “LPS”
700PGH-16	7,000 lb. capacity, K25 gasoline engine, pneumatic tires
700PGSH-16	7,000 lb. capacity, K25 gasoline engine, pneumatic tires, “GS”
700PGLH-16	7,000 lb. capacity, K25 LPG engine, pneumatic tires, “LPS”
DIESEL ENGINE MODELS	
400PD-16	4,000 lb. capacity, 4D94E diesel engine, pneumatic tires
400PDS-16	4,000 lb. capacity, 4D94E diesel engine, pneumatic tires, “DS”
500PD-16	5,000 lb. capacity, 4D94E diesel engine, pneumatic tires
500PDS-16	5,000 lb. capacity, 4D94E diesel engine, pneumatic tires, “DS”
550PD-16	5,500 lb. capacity, 4D94E diesel engine, pneumatic tires
550PDS-16	5,500 lb. capacity, 4D94E diesel engine, pneumatic tires. “DS”
600PD-16	6,000 lb. capacity, 4D94E diesel engine, pneumatic tires
600PDS-16	6,000 lb. capacity, 4D94E diesel engine, pneumatic tires. “DS”
650PD-16	6,500 lb. capacity, 4D94E diesel engine, pneumatic tires
650PDS-16	6,500 lb. capacity, 4D94E diesel engine, pneumatic tires, “DS”
700PD-16	7,000 lb. capacity, 4D94E diesel engine, pneumatic tires
700PDS-16	7,000 lb. capacity, 4D94E diesel engine, pneumatic tires, “DS”